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DOI: https://doi.org/10.1093/bja/63.7.112



Originally published at:
Spahn, D R; Schmid, E R; Bush, E H; Leuthold, R; Niederer, P F (1989). Resonant amplification during high frequency oscillation. British Journal of Anaesthesia, 63(7):112S.
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*Br. J. Anaesth.* (1989), **63**, 112S

# RESONANT AMPLIFICATION DURING HIGH FREQUENCY OSCILLATION

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During artificial ventilation by means of high frequency oscillation the oscillatory volume effectively delivered to the lungs (*V*del)—that is, the oscillatory volume at the tip of the tracheal tube—is difficult to measure and is often approximated by the piston displacement. It was shown, however, by *in vitro* experiments [1] in addition to computer simulations [2], that *V*del generally is not equal to the piston volume displacement. Part of the oscillatory volume may be lost through the bias tube; in addition, there is resonance amplification within the HFO system.

For the formation of these resonances, the wave propagation characteristics of oscillatory flow are critical. Oscillatory waves are reflected at tube ends, at the piston pump and at bifurcations; resonances result by constructive superposition of primary and reflected waves. HFO circuit properties were found to be decisive for the resonance characteristics. The length of the connecting tube from the piston pump to the lung surrogate and the deadspace volume of the piston pump were found to be critical determinants of resonance frequency, whilst damping characteristics of the HFO tubing were shown to be critical for resonant amplification. In turn, mechanical lung properties were found to have an insignificant influence upon the ratio of *V*del to the piston volume displacement. By using these facts, an *in vitro* calibration of the HFO system is possible: *V*del can be determined for each piston displacement and any oscillatory frequency. For subsequent applications, *in vitro* and *in vivo*, the oscillatory volume effectively delivered to the lungs is thus a known parameter and comparative investigations with equal *V*del become possible. This is of outstanding importance for studies determining the influence of HFO system modifications upon gas transport.

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